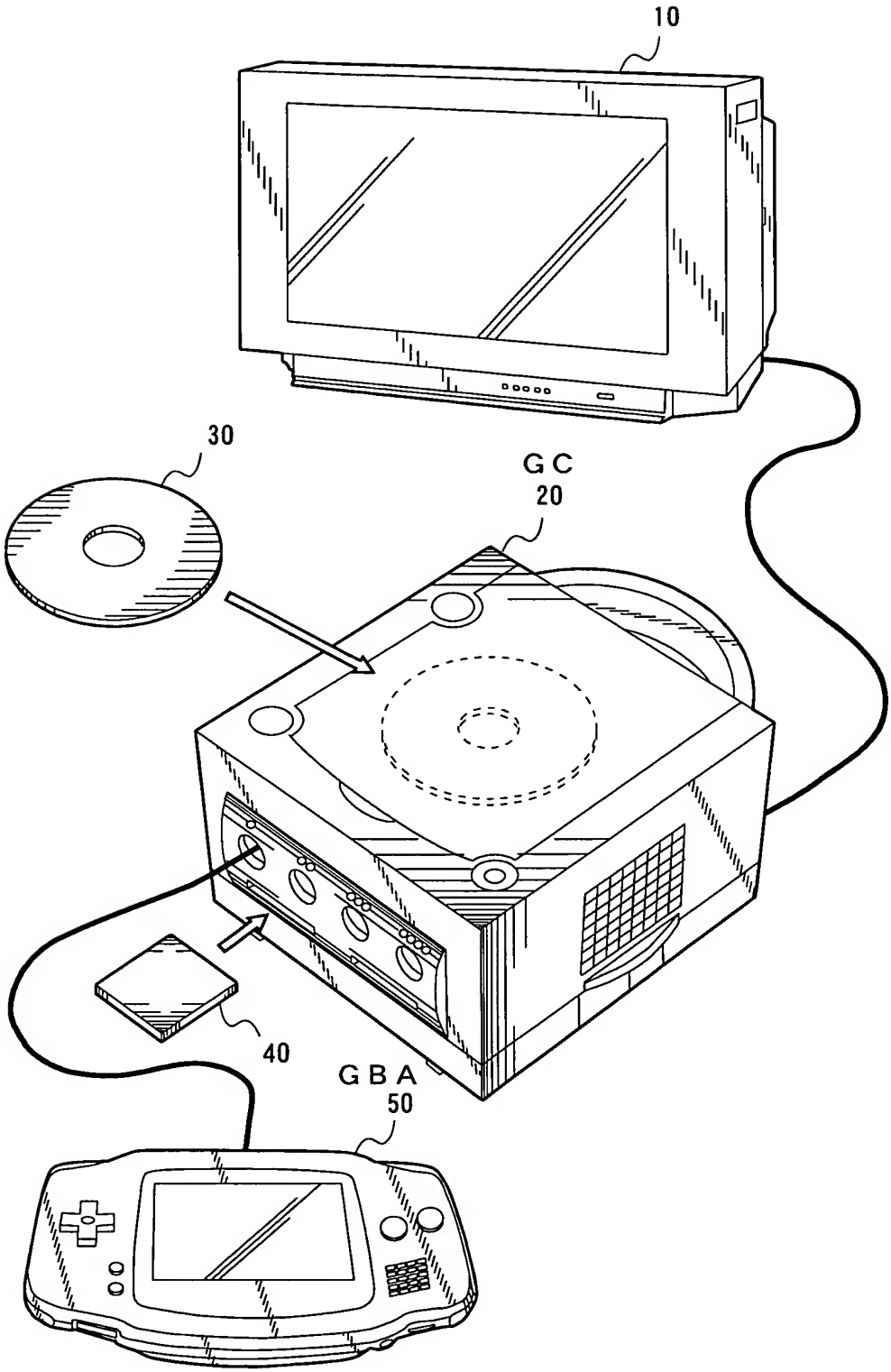
F I G. 1



F I G. 2

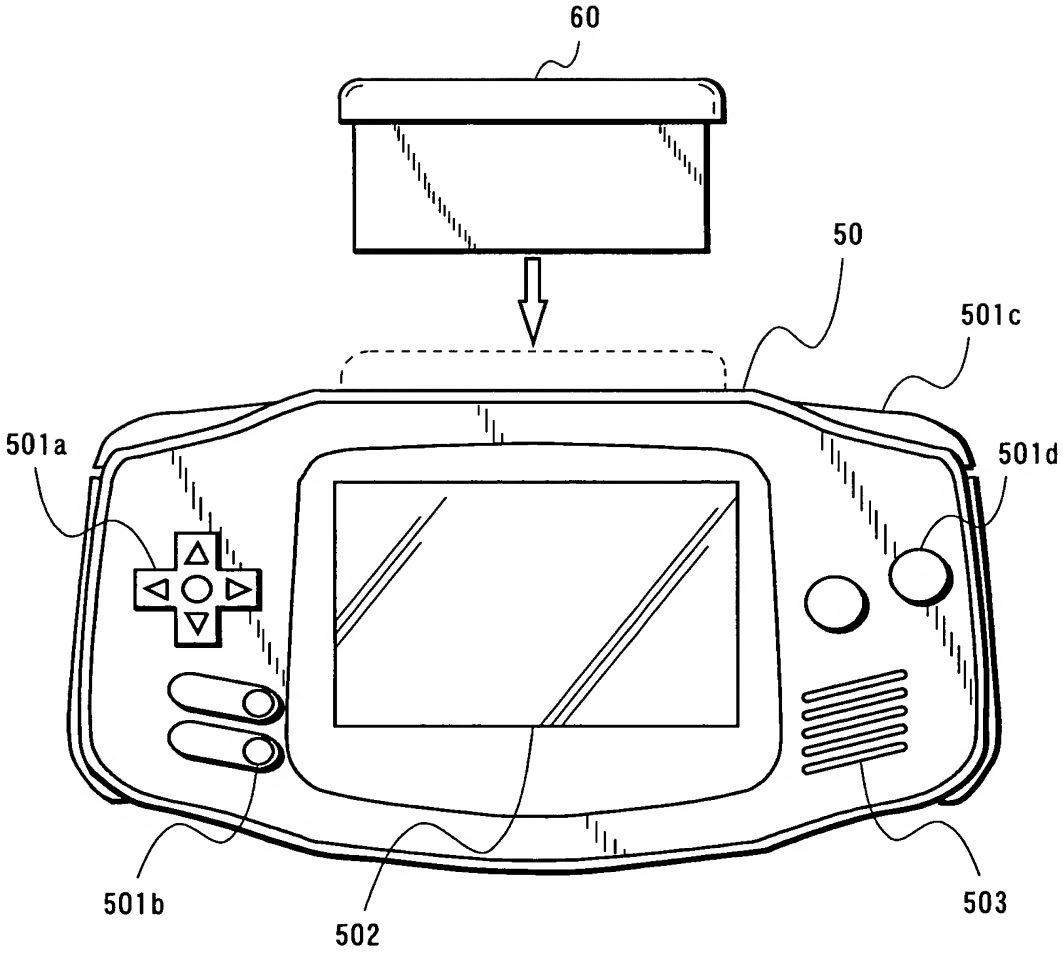


FIG. 3

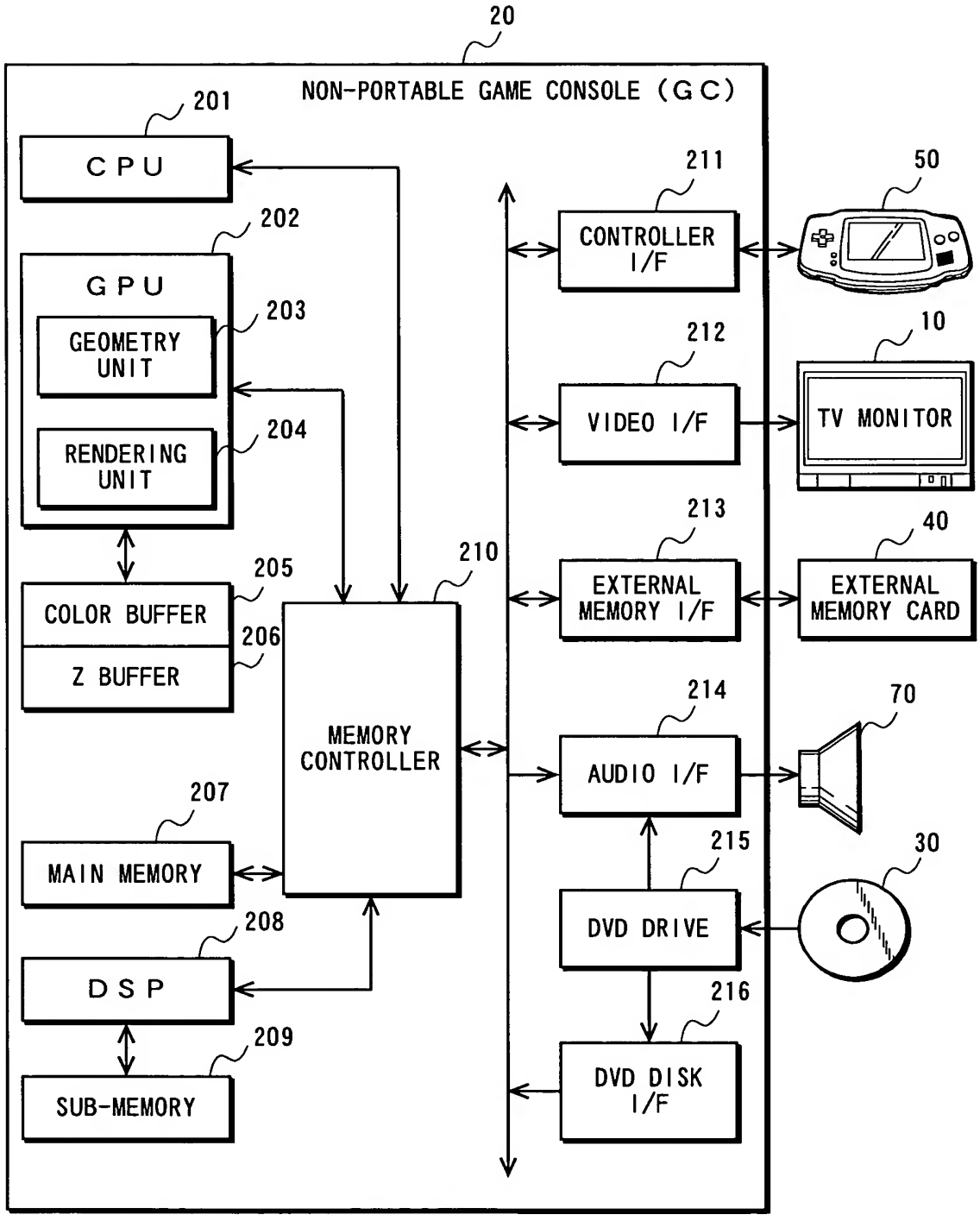

20
NON-PORTABLE GAME CONSOLE (GC)
201
CPU
202
GPU
203
GEOMETRY UNIT
204
RENDERING UNIT
205
COLOR BUFFER
206
Z BUFFER
207
MAIN MEMORY
208
DSP
209
SUB-MEMORY
210
MEMORY CONTROLLER
211
CONTROLLER I/F
212
VIDEO I/F
213
EXTERNAL MEMORY I/F
214
AUDIO I/F
215
DVD DRIVE
216
DVD DISK I/F
50
10
TV MONITOR
40
EXTERNAL MEMORY CARD
70
30

FIG. 4

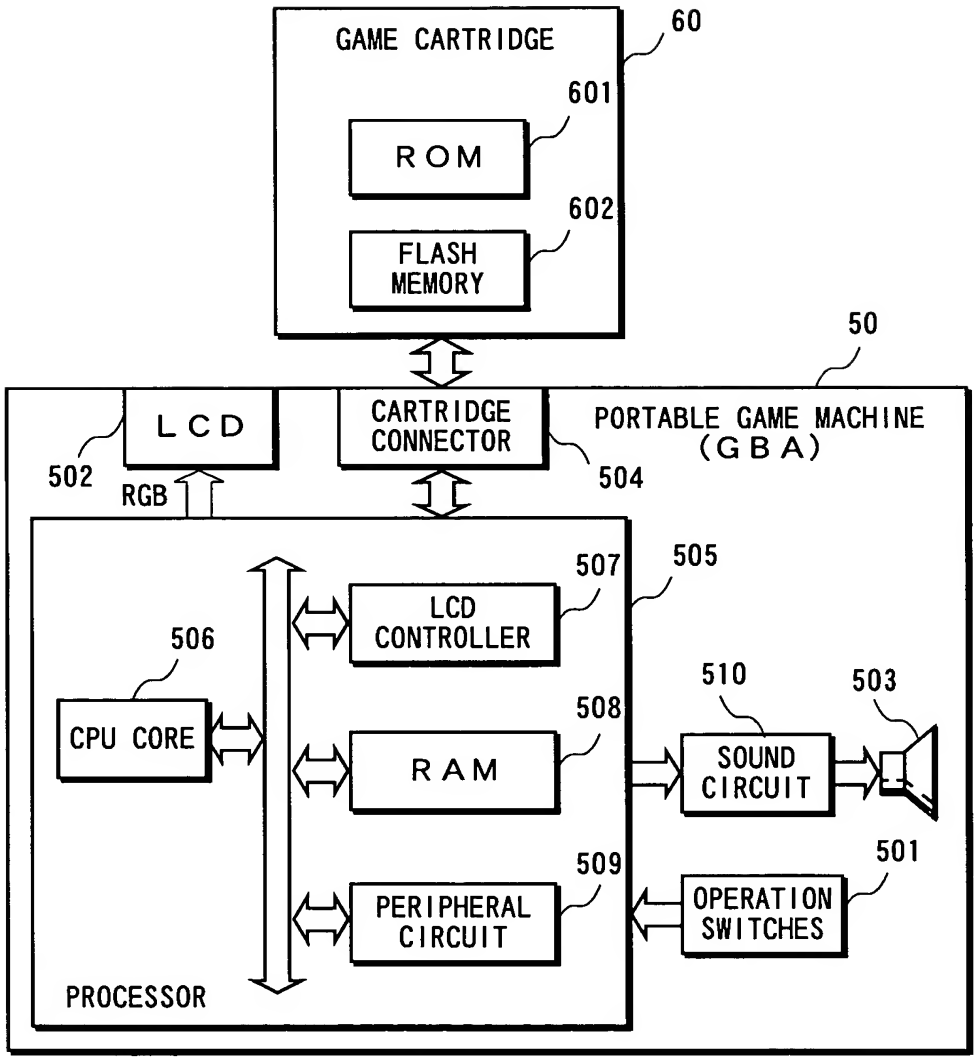

GAME CARTRIDGE
60
601
ROM
602
FLASH MEMORY
50
LCD
502
CARTRIDGE CONNECTOR
504
PORTABLE GAME MACHINE (GBA)
RGB
505
507
LCD CONTROLLER
506
CPU CORE
510
503
508
RAM
SOUND CIRCUIT
501
509
PERIPHERAL CIRCUIT
OPERATION SWITCHES
PROCESSOR

FIG. 5

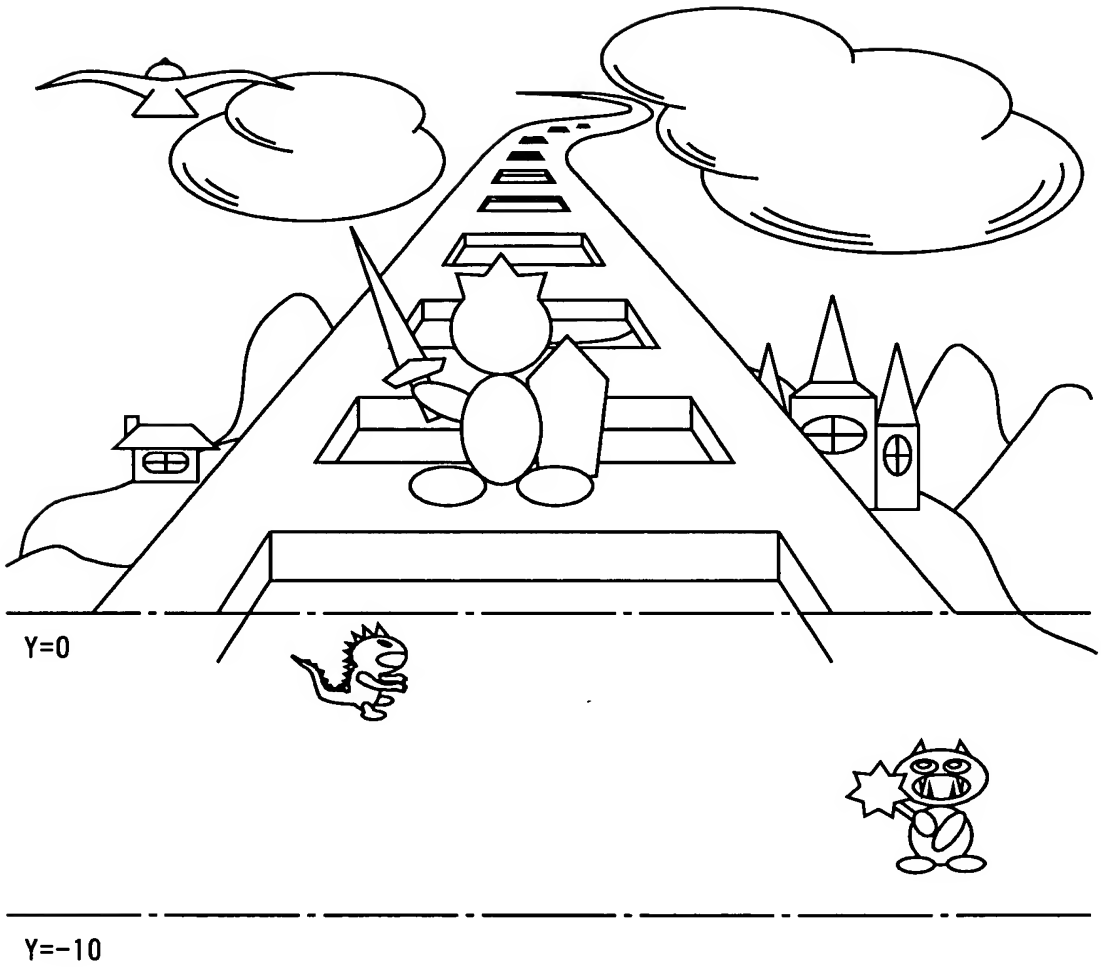


FIG. 6

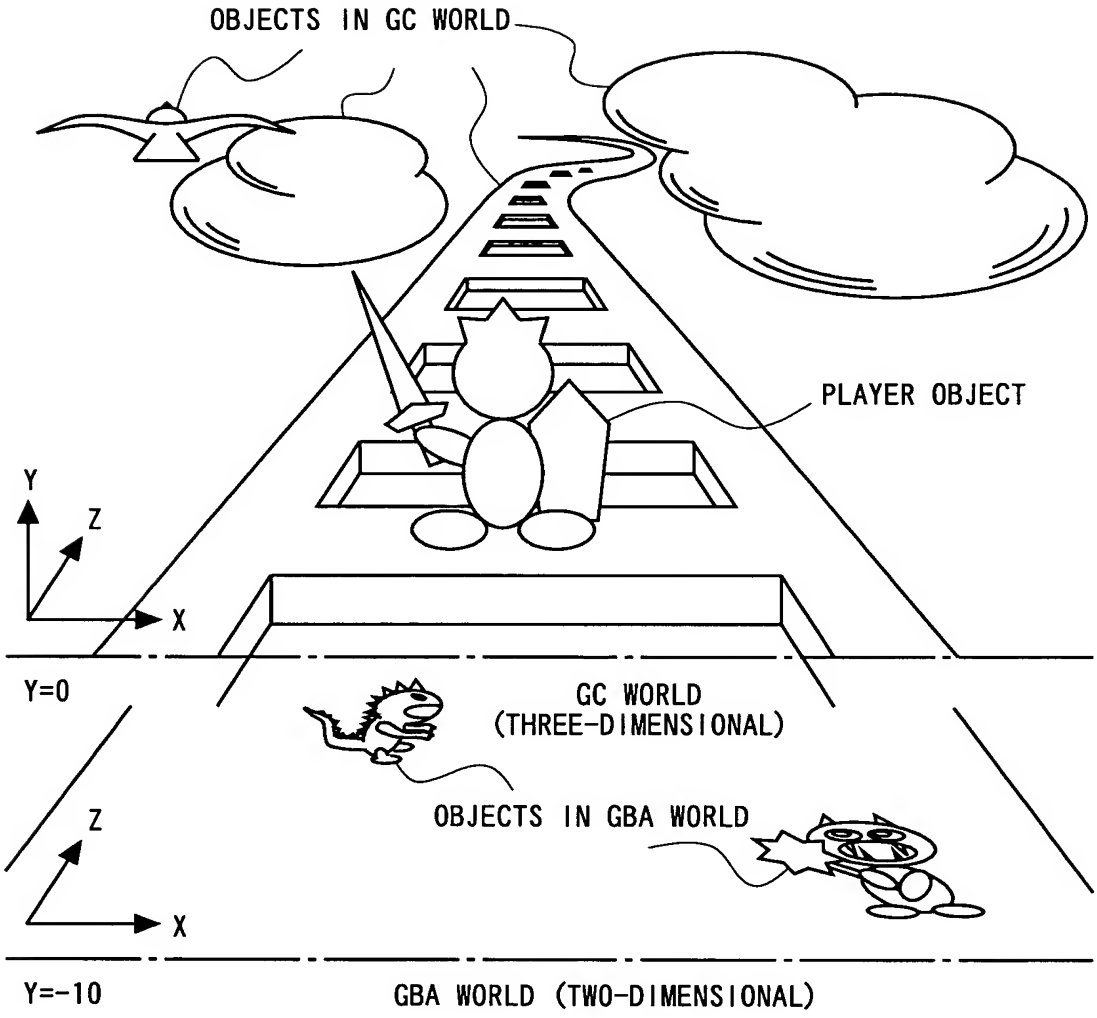

OBJECTS IN GC WORLD
PLAYER OBJECT
Y
Z
X
Y=0
GC WORLD
(THREE-DIMENSIONAL)
OBJECTS IN GBA WORLD
Z
X
Y=-10
GBA WORLD (TWO-DIMENSIONAL)

FIG. 7A

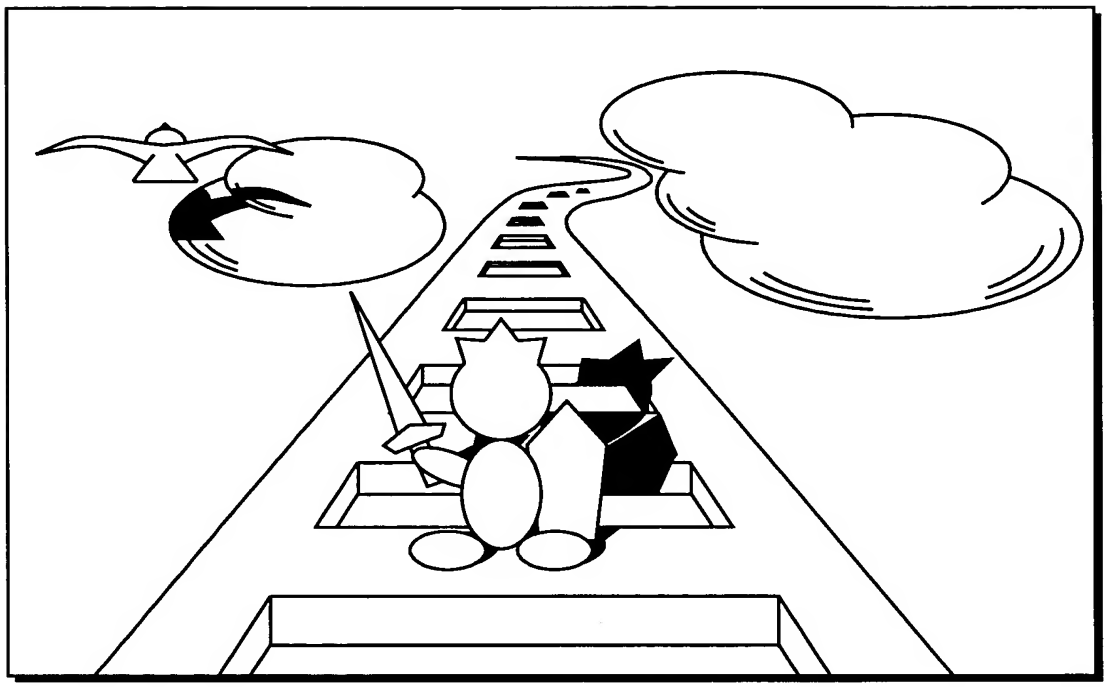


FIG. 7B

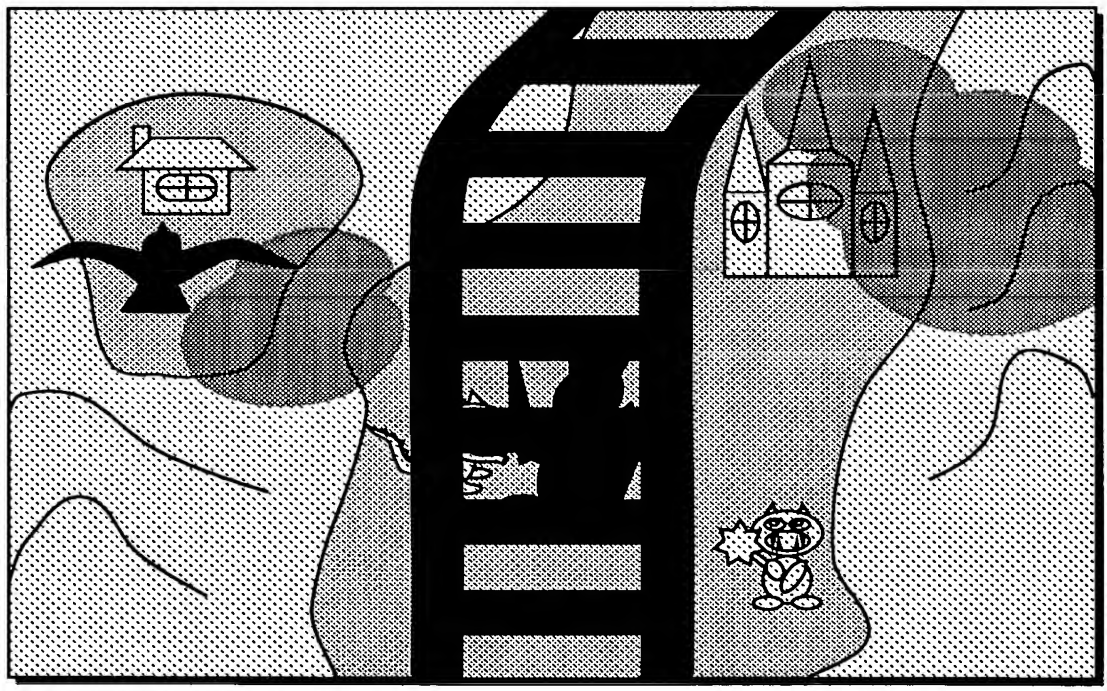


FIG. 8

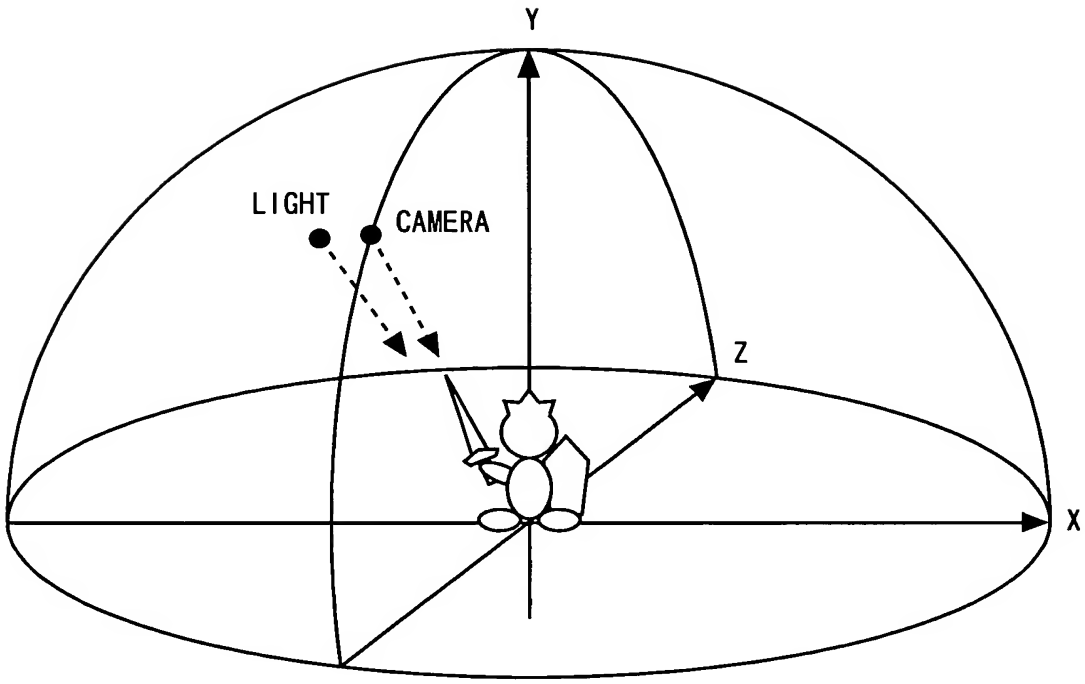


FIG. 9

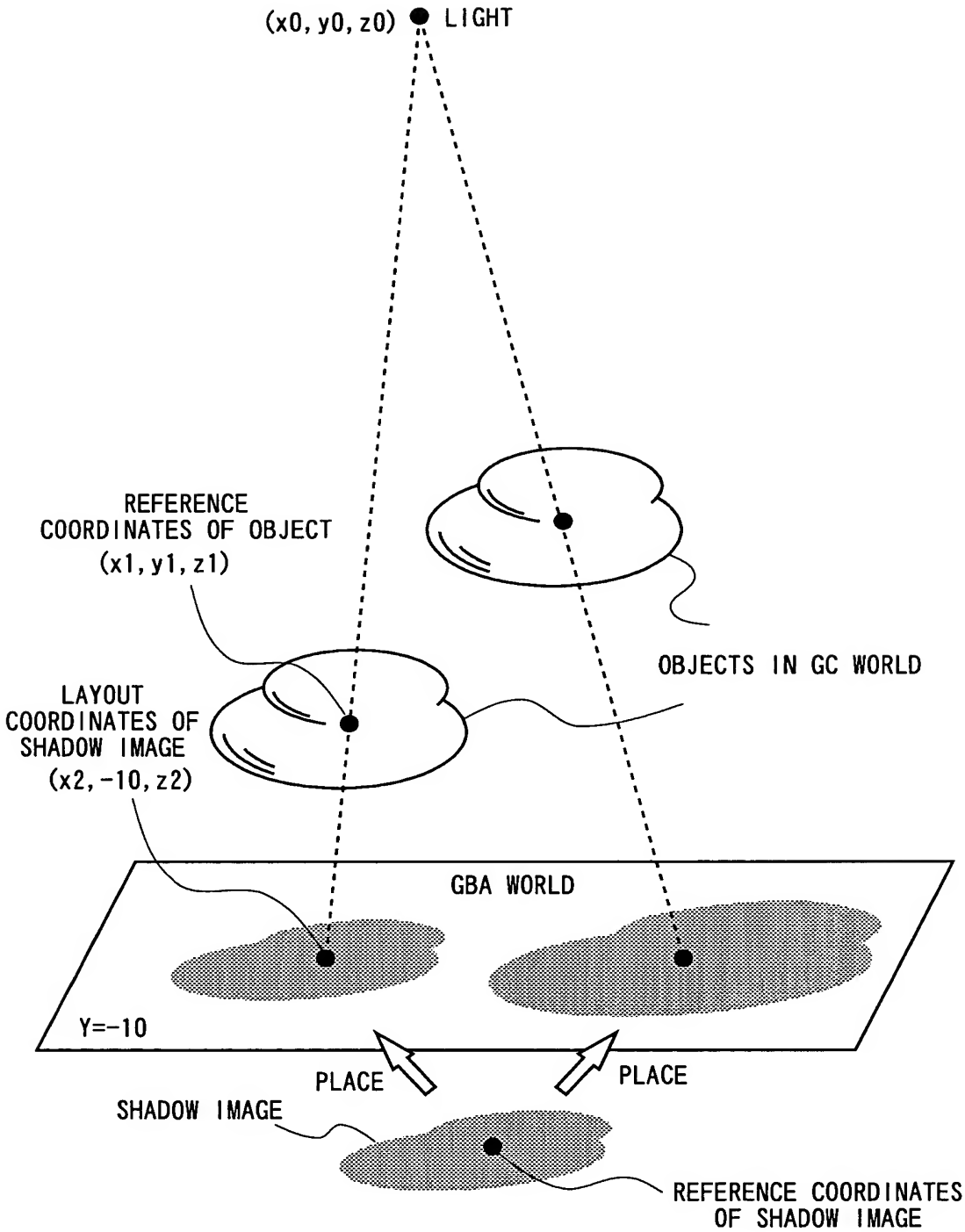

(x0, y0, z0)
LIGHT
REFERENCE
COORDINATES OF OBJECT
(x1, y1, z1)
OBJECTS IN GC WORLD
LAYOUT
COORDINATES OF
SHADOW IMAGE
(x2, -10, z2)
GBA WORLD
Y=-10
PLACE
PLACE
SHADOW IMAGE
REFERENCE COORDINATES
OF SHADOW IMAGE

FIG. 10

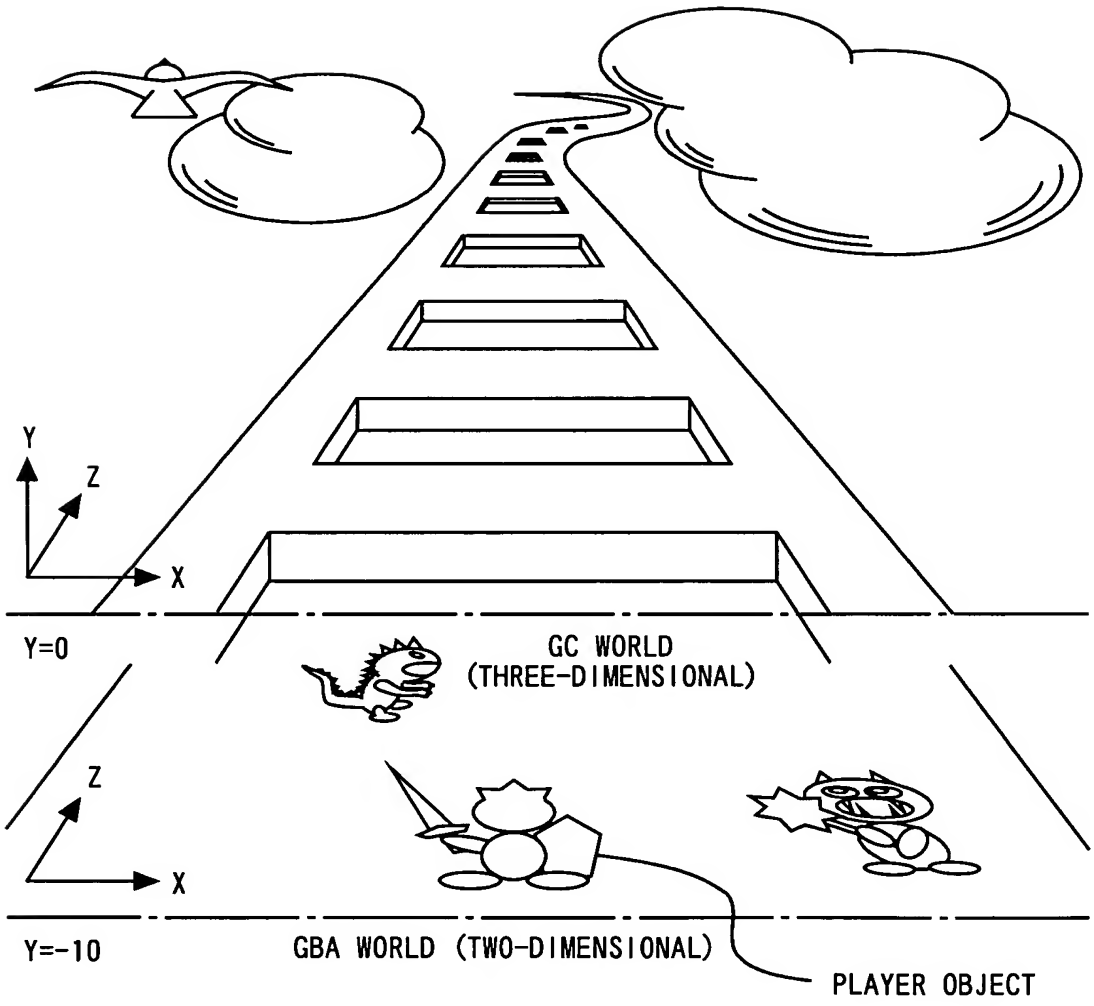

Y
Z
X
Y=0
GC WORLD
(THREE-DIMENSIONAL)
Z
X
Y=-10
GBA WORLD (TWO-DIMENSIONAL)
PLAYER OBJECT

FIG. 11A

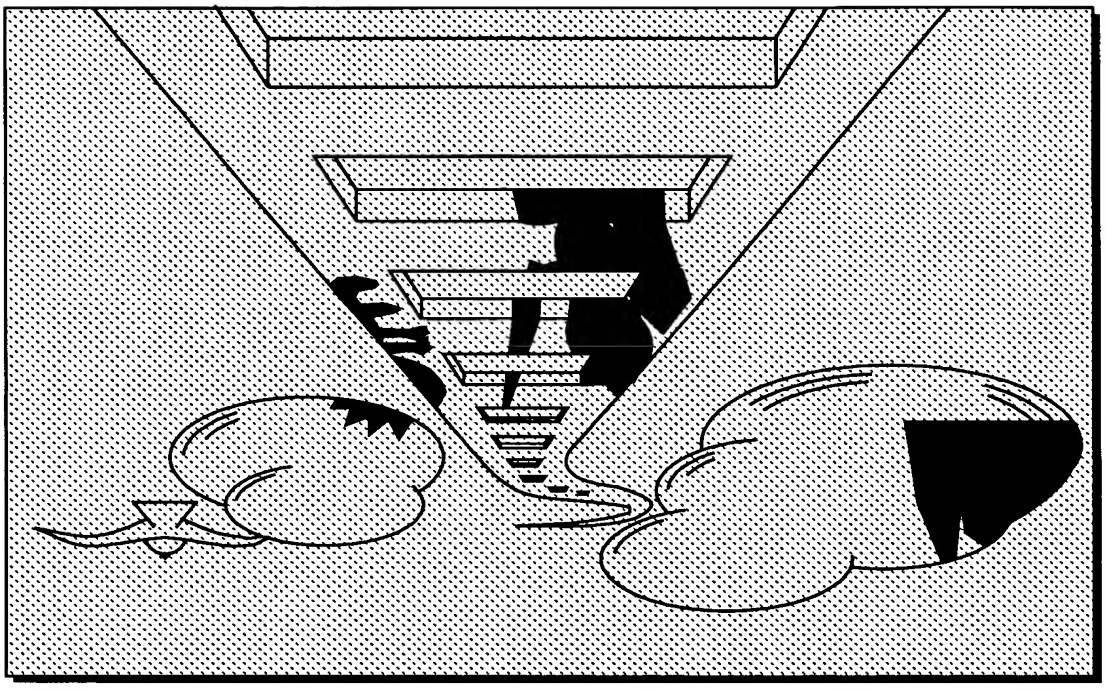


FIG. 11B

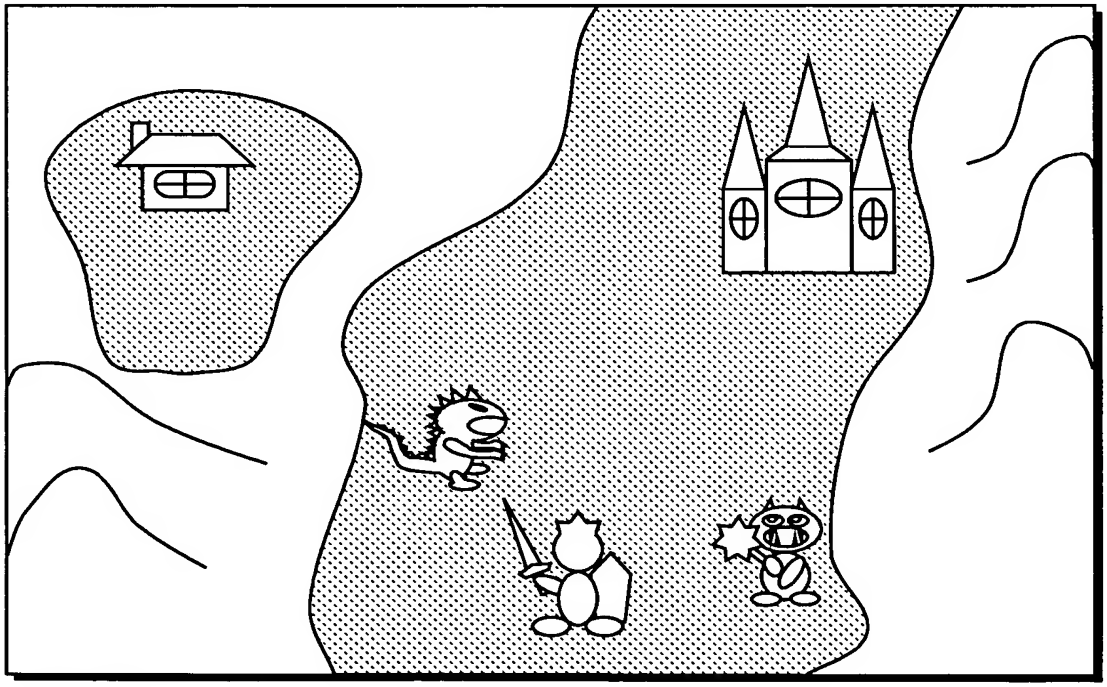


FIG. 12

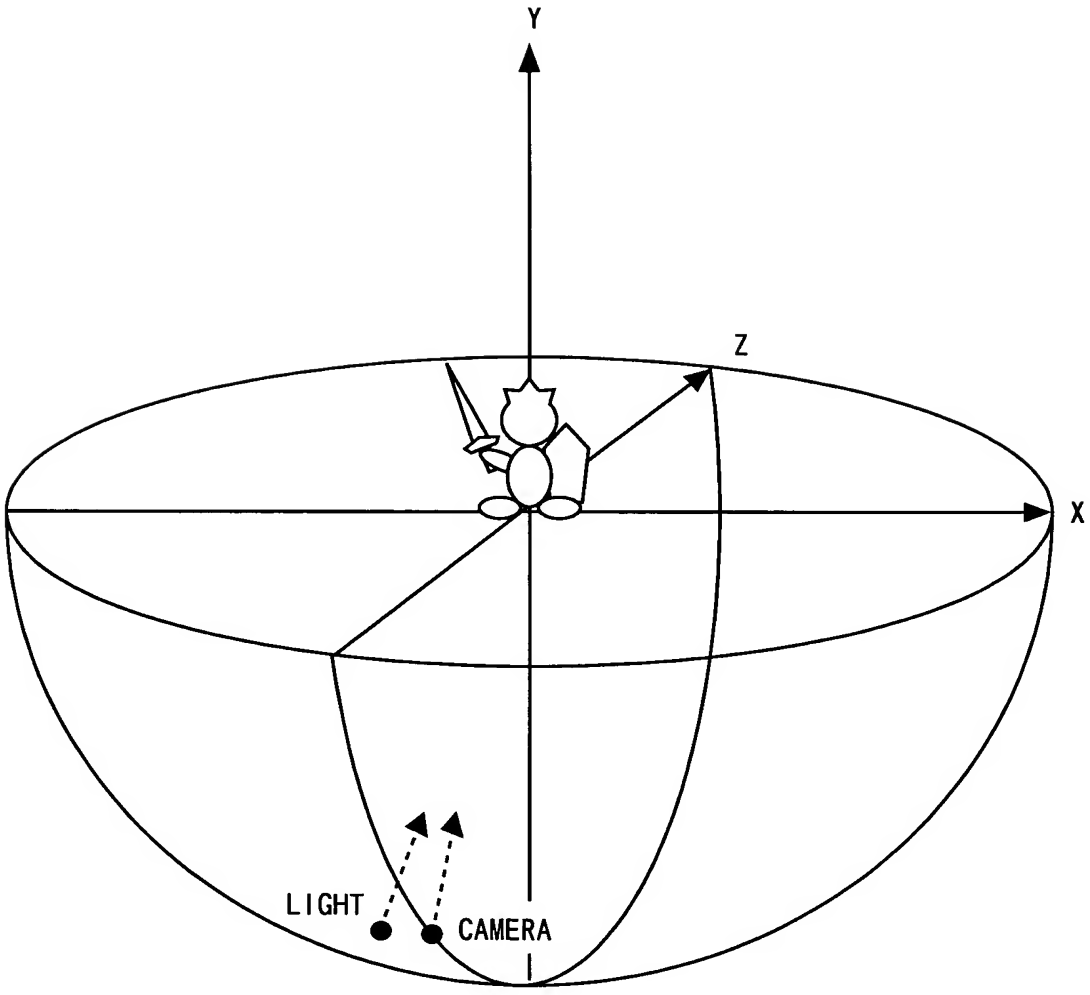


FIG. 13

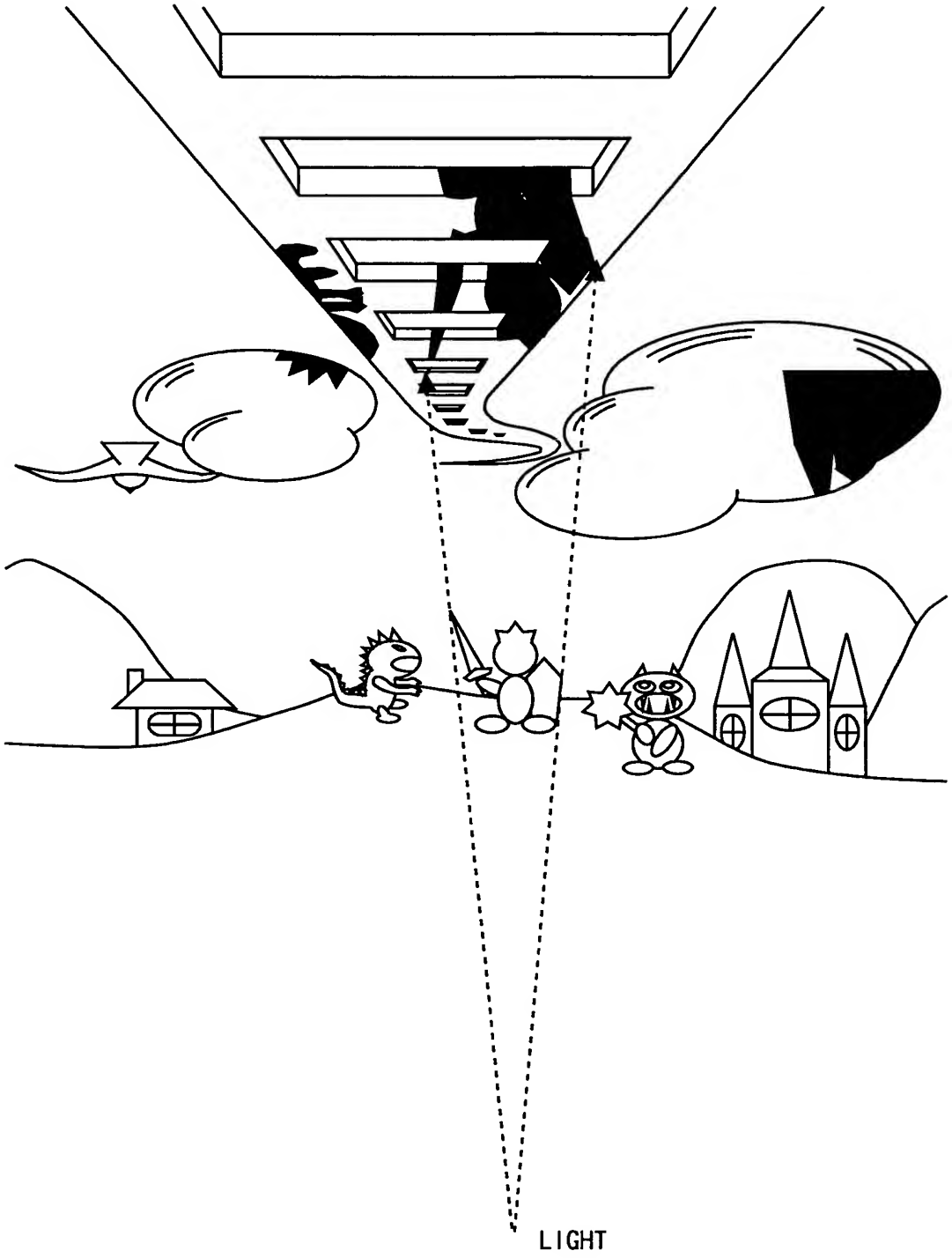


FIG. 14

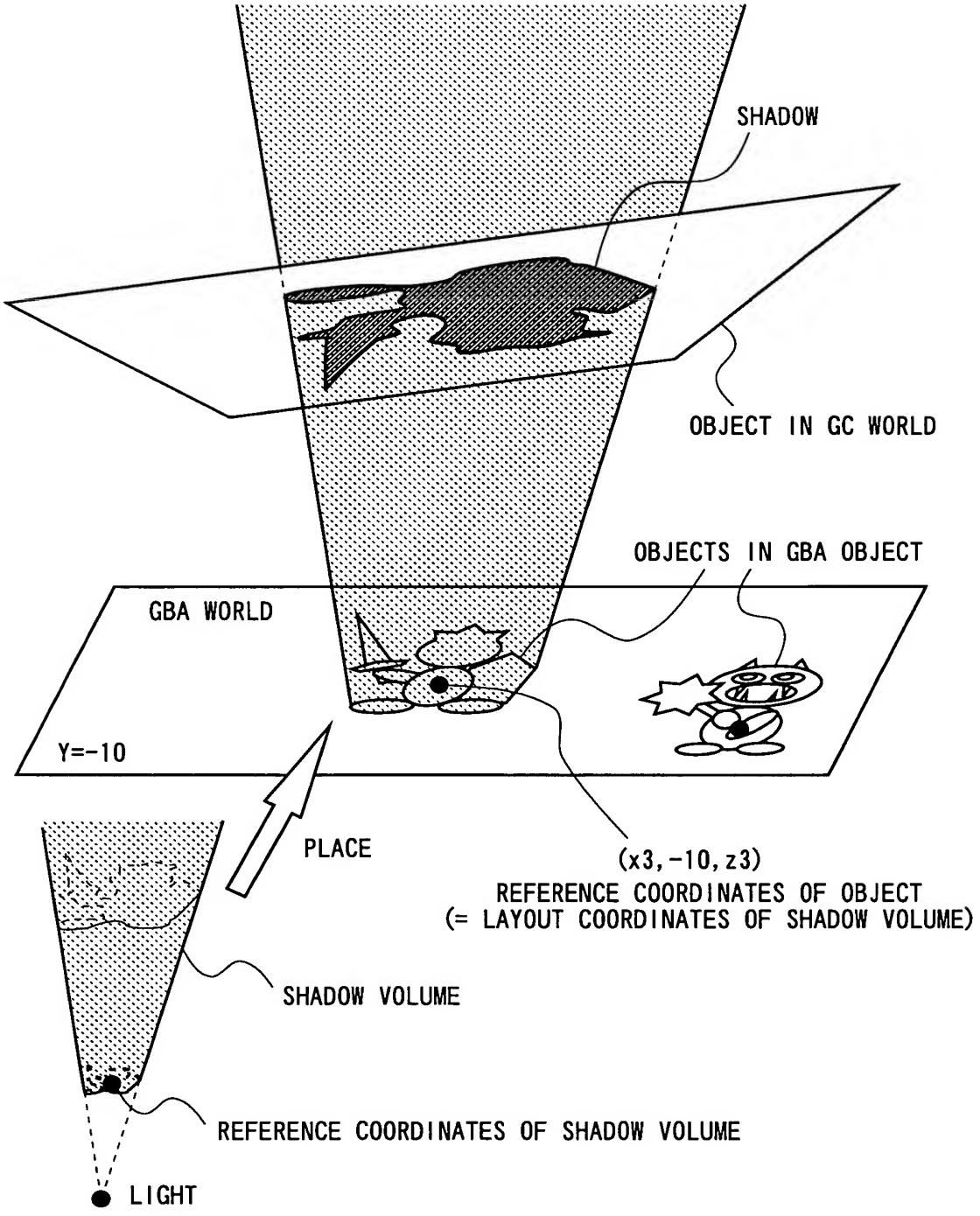

SHADOW
OBJECT IN GC WORLD
OBJECTS IN GBA OBJECT
GBA WORLD
Y=-10
PLACE
(x3, -10, z3)
REFERENCE COORDINATES OF OBJECT
(= LAYOUT COORDINATES OF SHADOW VOLUME)
SHADOW VOLUME
REFERENCE COORDINATES OF SHADOW VOLUME
LIGHT

FIG. 15

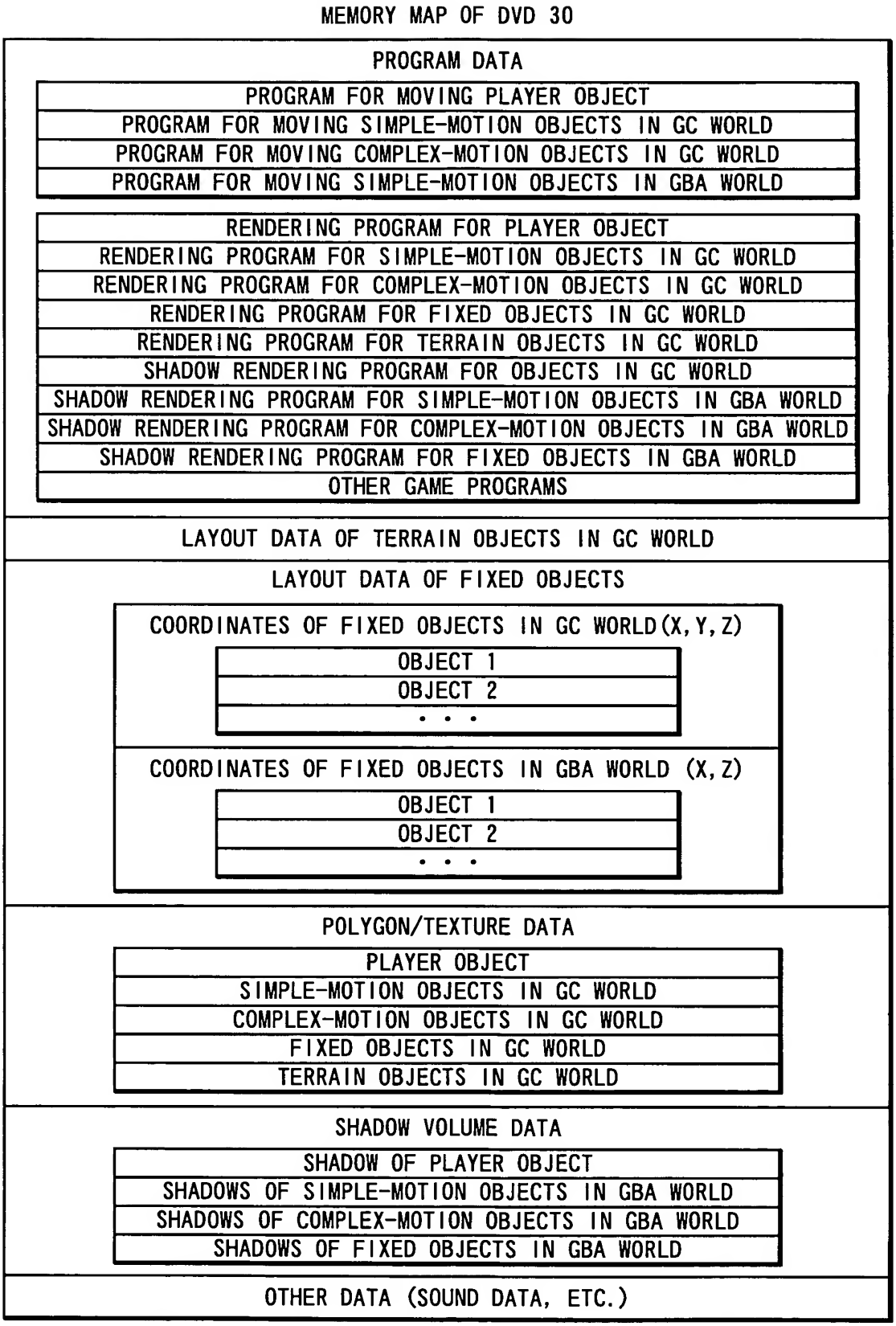

MEMORY MAP OF DVD 30
PROGRAM DATA
PROGRAM FOR MOVING PLAYER OBJECT
PROGRAM FOR MOVING SIMPLE-MOTION OBJECTS IN GC WORLD
PROGRAM FOR MOVING COMPLEX-MOTION OBJECTS IN GC WORLD
PROGRAM FOR MOVING SIMPLE-MOTION OBJECTS IN GBA WORLD
RENDERING PROGRAM FOR PLAYER OBJECT
RENDERING PROGRAM FOR SIMPLE-MOTION OBJECTS IN GC WORLD
RENDERING PROGRAM FOR COMPLEX-MOTION OBJECTS IN GC WORLD
RENDERING PROGRAM FOR FIXED OBJECTS IN GC WORLD
RENDERING PROGRAM FOR TERRAIN OBJECTS IN GC WORLD
SHADOW RENDERING PROGRAM FOR OBJECTS IN GC WORLD
SHADOW RENDERING PROGRAM FOR SIMPLE-MOTION OBJECTS IN GBA WORLD
SHADOW RENDERING PROGRAM FOR COMPLEX-MOTION OBJECTS IN GBA WORLD
SHADOW RENDERING PROGRAM FOR FIXED OBJECTS IN GBA WORLD
OTHER GAME PROGRAMS
LAYOUT DATA OF TERRAIN OBJECTS IN GC WORLD
LAYOUT DATA OF FIXED OBJECTS
COORDINATES OF FIXED OBJECTS IN GC WORLD(X,Y,Z)
OBJECT 1
OBJECT 2
• • •
COORDINATES OF FIXED OBJECTS IN GBA WORLD (X,Z)
OBJECT 1
OBJECT 2
• • •
POLYGON/TEXTURE DATA
PLAYER OBJECT
SIMPLE-MOTION OBJECTS IN GC WORLD
COMPLEX-MOTION OBJECTS IN GC WORLD
FIXED OBJECTS IN GC WORLD
TERRAIN OBJECTS IN GC WORLD
SHADOW VOLUME DATA
SHADOW OF PLAYER OBJECT
SHADOWS OF SIMPLE-MOTION OBJECTS IN GBA WORLD
SHADOWS OF COMPLEX-MOTION OBJECTS IN GBA WORLD
SHADOWS OF FIXED OBJECTS IN GBA WORLD
OTHER DATA (SOUND DATA, ETC.)

FIG. 16

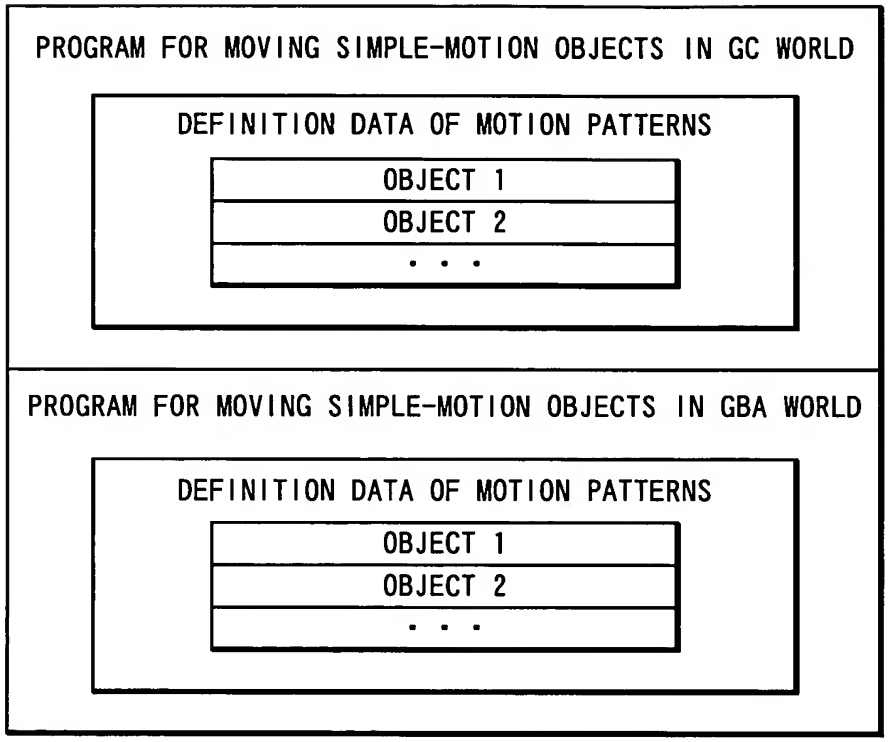

PROGRAM FOR MOVING SIMPLE-MOTION OBJECTS IN GC WORLD
DEFINITION DATA OF MOTION PATTERNS
OBJECT 1
OBJECT 2
• • •
PROGRAM FOR MOVING SIMPLE-MOTION OBJECTS IN GBA WORLD
DEFINITION DATA OF MOTION PATTERNS
OBJECT 1
OBJECT 2
• • •

FIG. 17

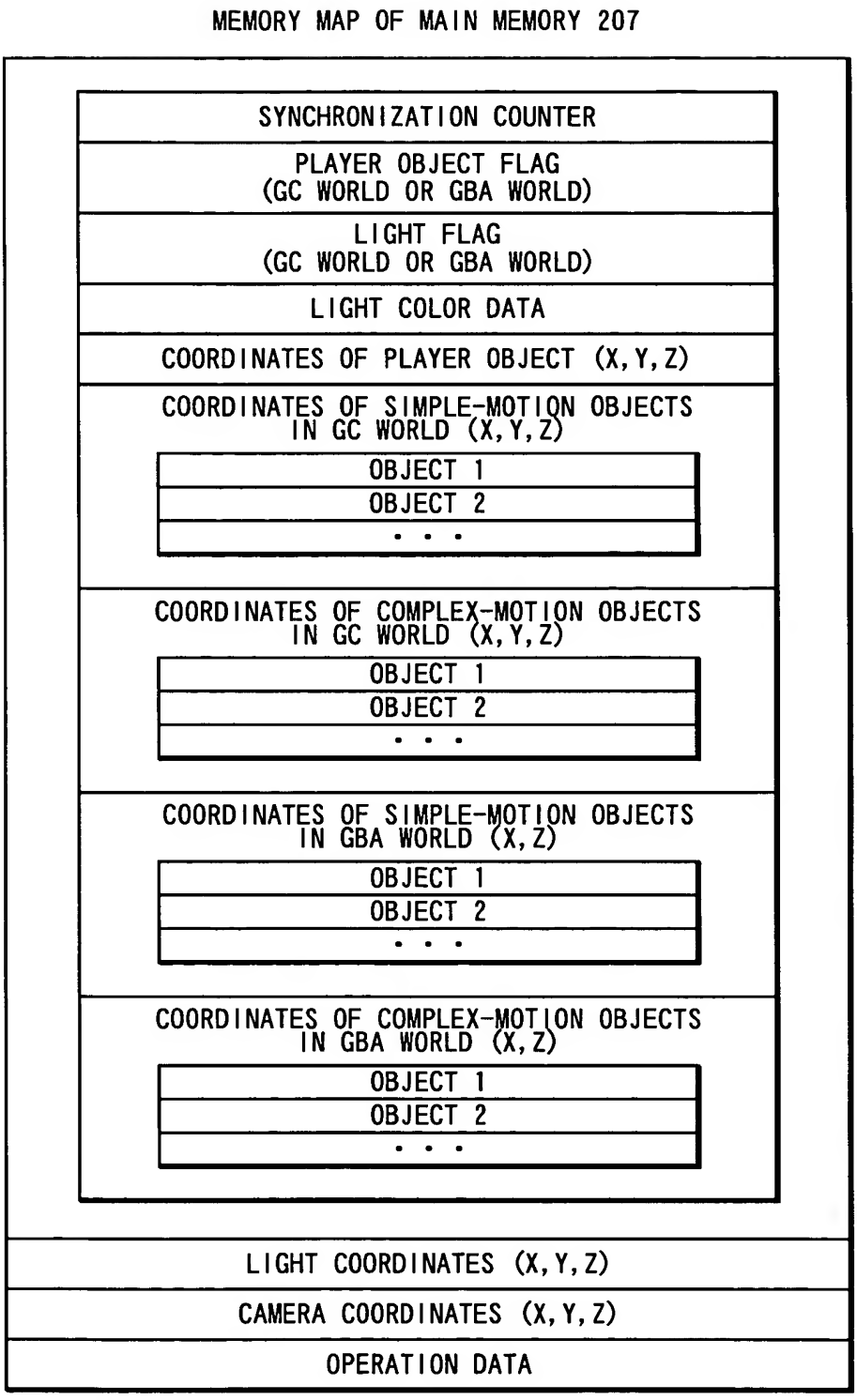

MEMORY MAP OF MAIN MEMORY 207
SYNCHRONIZATION COUNTER
PLAYER OBJECT FLAG (GC WORLD OR GBA WORLD)
LIGHT FLAG (GC WORLD OR GBA WORLD)
LIGHT COLOR DATA
COORDINATES OF PLAYER OBJECT (X,Y,Z)
COORDINATES OF SIMPLE-MOTION OBJECTS IN GC WORLD (X,Y,Z)
OBJECT 1
OBJECT 2
• • •
COORDINATES OF COMPLEX-MOTION OBJECTS IN GC WORLD (X,Y,Z)
OBJECT 1
OBJECT 2
• • •
COORDINATES OF SIMPLE-MOTION OBJECTS IN GBA WORLD (X,Z)
OBJECT 1
OBJECT 2
• • •
COORDINATES OF COMPLEX-MOTION OBJECTS IN GBA WORLD (X,Z)
OBJECT 1
OBJECT 2
• • •
LIGHT COORDINATES (X,Y,Z)
CAMERA COORDINATES (X,Y,Z)
OPERATION DATA

FIG. 18

MEMORY MAP OF ROM 601

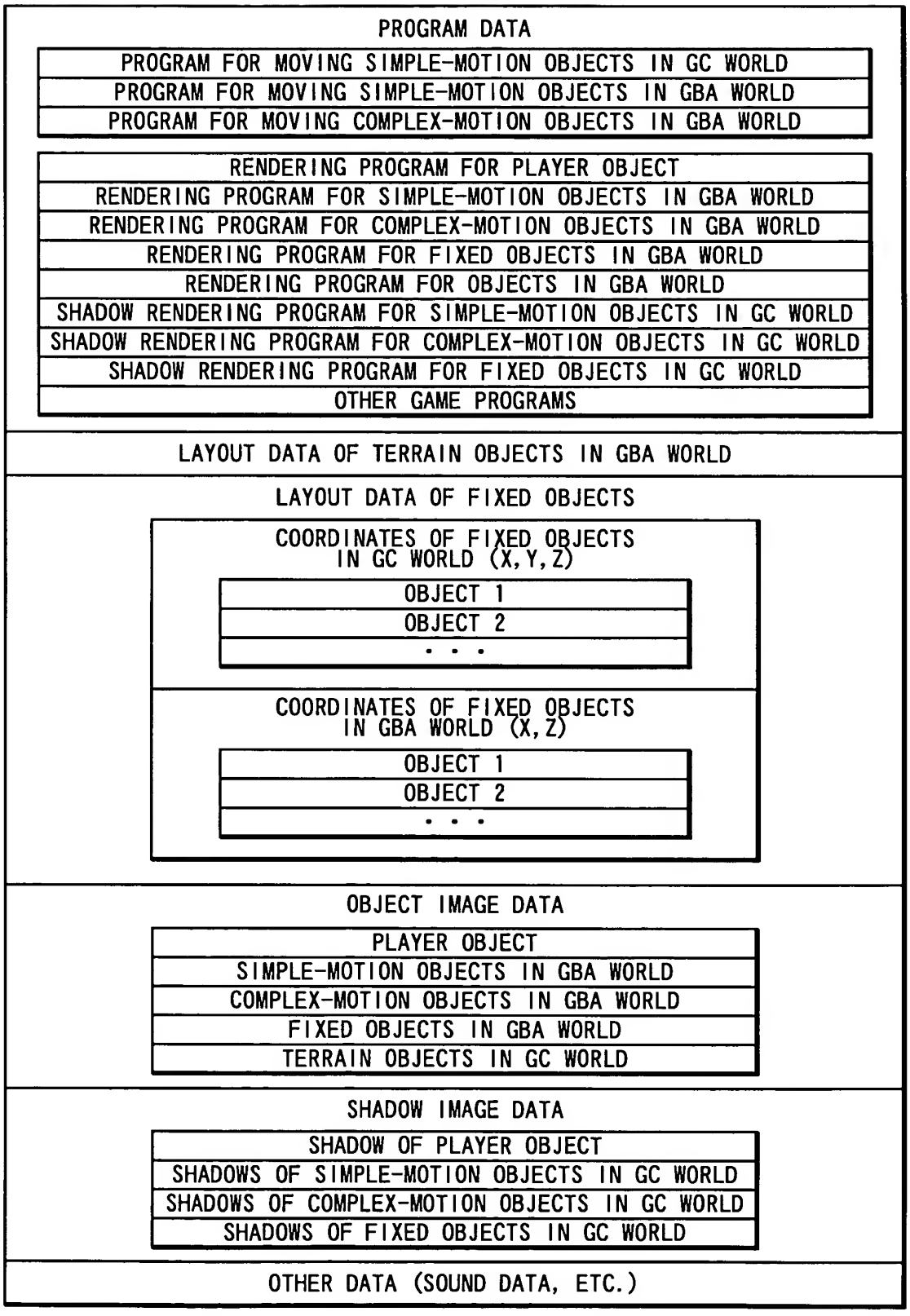


FIG. 19

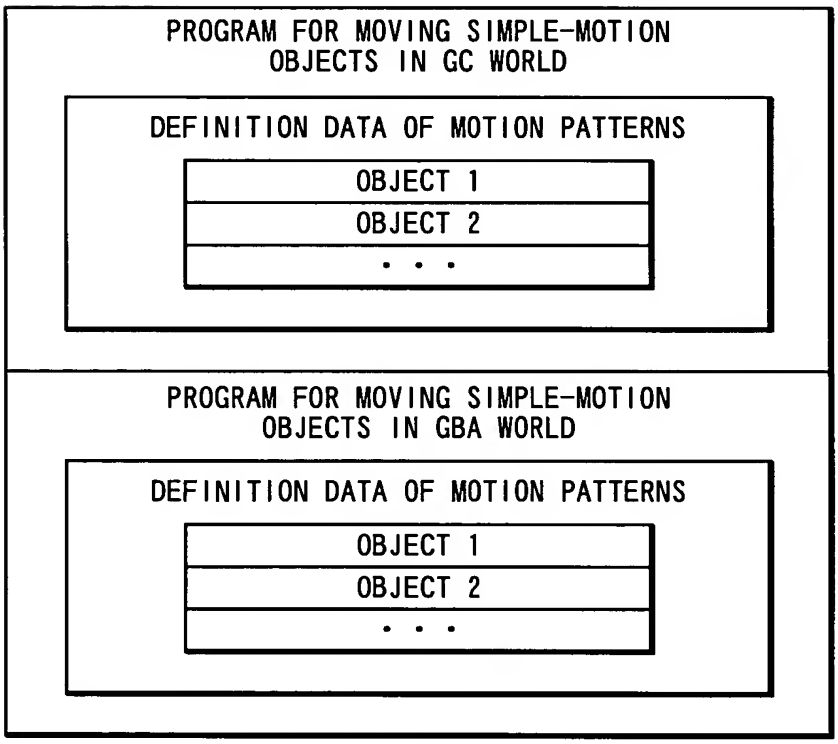

PROGRAM FOR MOVING SIMPLE-MOTION OBJECTS IN GC WORLD
DEFINITION DATA OF MOTION PATTERNS
OBJECT 1
OBJECT 2
• • •
PROGRAM FOR MOVING SIMPLE-MOTION OBJECTS IN GBA WORLD
DEFINITION DATA OF MOTION PATTERNS
OBJECT 1
OBJECT 2
• • •

FIG. 20

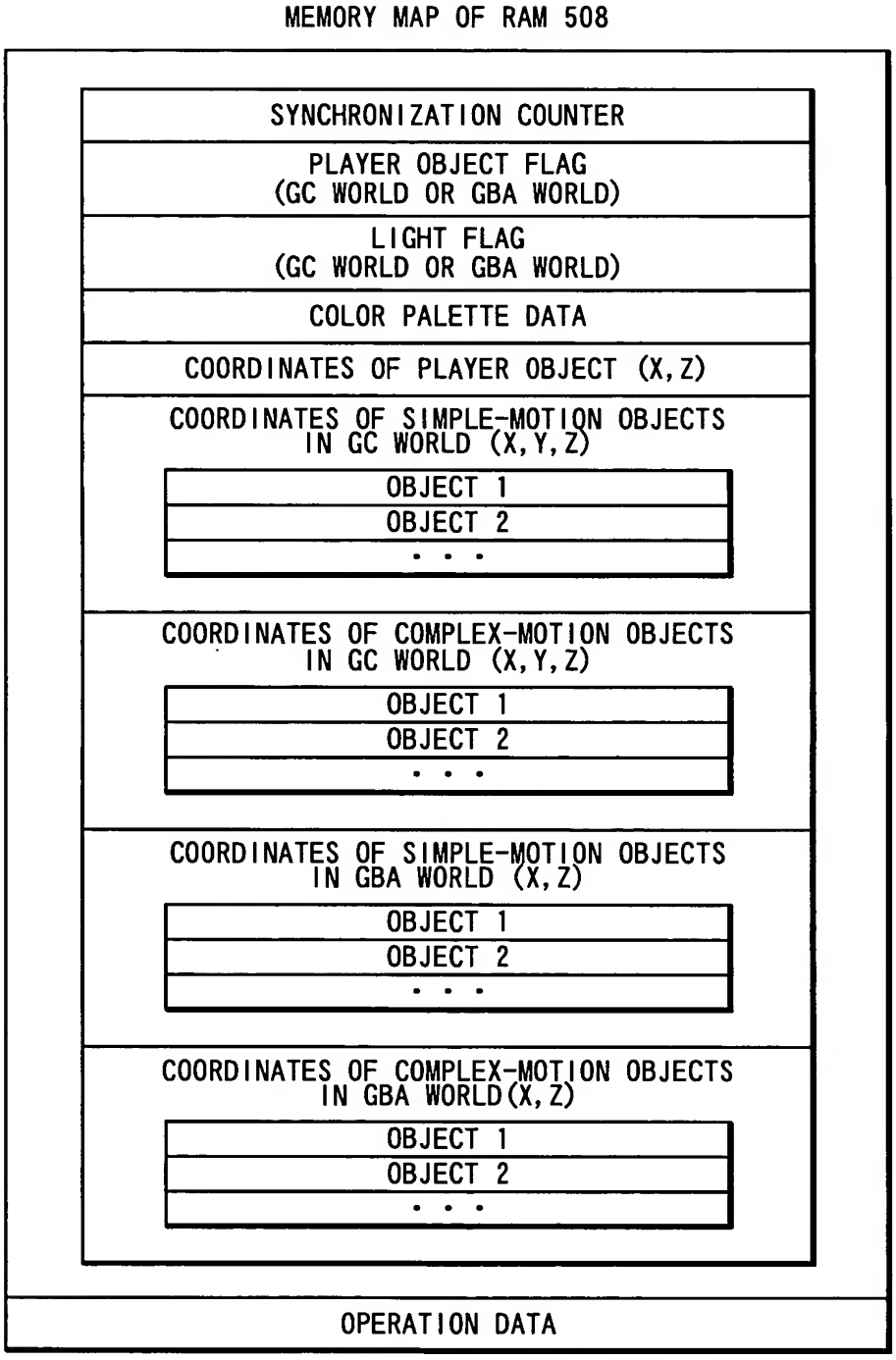

MEMORY MAP OF RAM 508
SYNCHRONIZATION COUNTER
PLAYER OBJECT FLAG
(GC WORLD OR GBA WORLD)
LIGHT FLAG
(GC WORLD OR GBA WORLD)
COLOR PALETTE DATA
COORDINATES OF PLAYER OBJECT (X,Z)
COORDINATES OF SIMPLE-MOTION OBJECTS
IN GC WORLD (X,Y,Z)
OBJECT 1
OBJECT 2
• • •
COORDINATES OF COMPLEX-MOTION OBJECTS
IN GC WORLD (X,Y,Z)
OBJECT 1
OBJECT 2
• • •
COORDINATES OF SIMPLE-MOTION OBJECTS
IN GBA WORLD (X,Z)
OBJECT 1
OBJECT 2
• • •
COORDINATES OF COMPLEX-MOTION OBJECTS
IN GBA WORLD(X,Z)
OBJECT 1
OBJECT 2
• • •
OPERATION DATA

FIG. 21

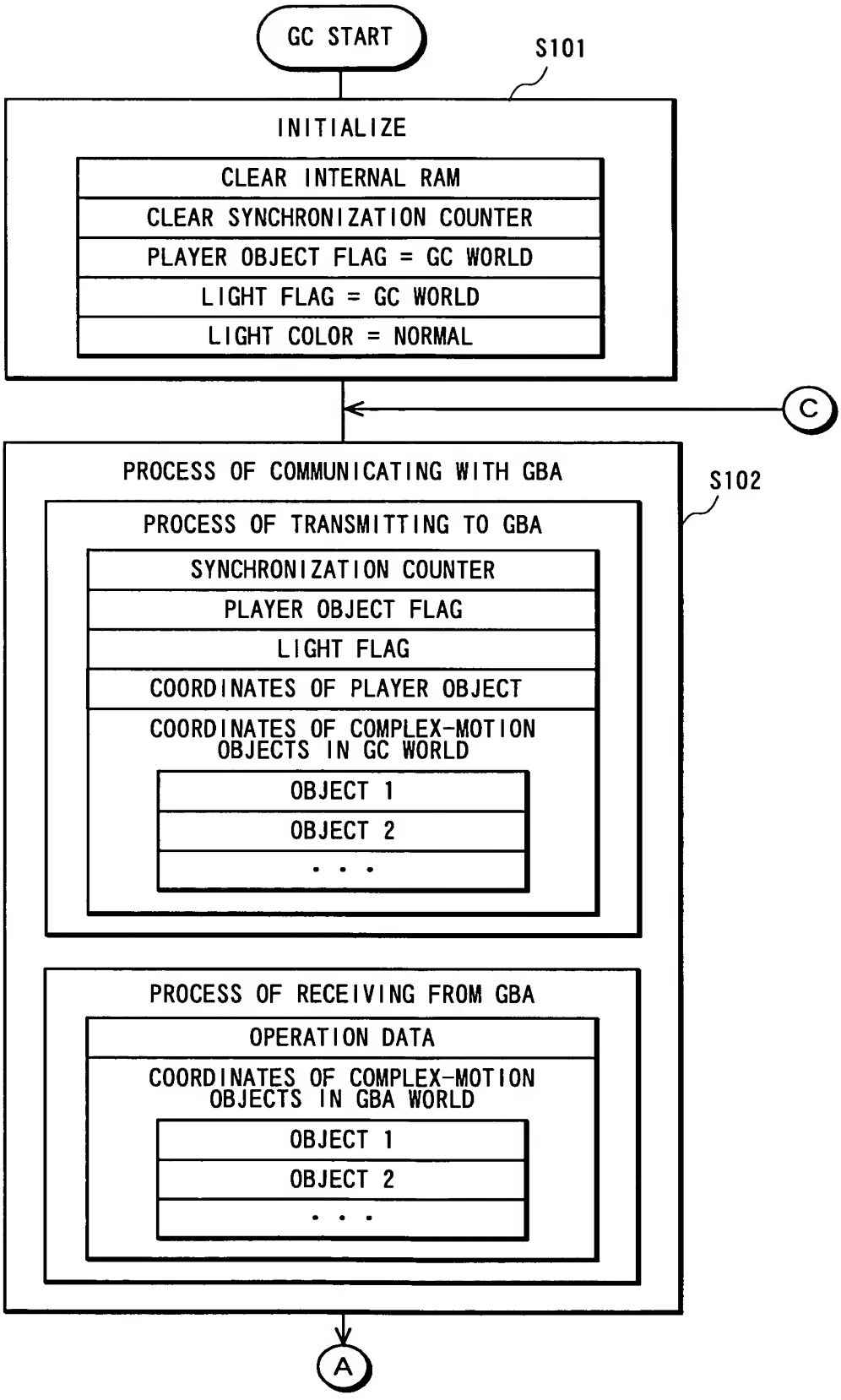

GC START
S101
INITIALIZE
CLEAR INTERNAL RAM
CLEAR SYNCHRONIZATION COUNTER
PLAYER OBJECT FLAG = GC WORLD
LIGHT FLAG = GC WORLD
LIGHT COLOR = NORMAL
C
PROCESS OF COMMUNICATING WITH GBA
S102
PROCESS OF TRANSMITTING TO GBA
SYNCHRONIZATION COUNTER
PLAYER OBJECT FLAG
LIGHT FLAG
COORDINATES OF PLAYER OBJECT
COORDINATES OF COMPLEX-MOTION OBJECTS IN GC WORLD
OBJECT 1
OBJECT 2
• • •
PROCESS OF RECEIVING FROM GBA
OPERATION DATA
COORDINATES OF COMPLEX-MOTION OBJECTS IN GBA WORLD
OBJECT 1
OBJECT 2
• • •
A

FIG. 22

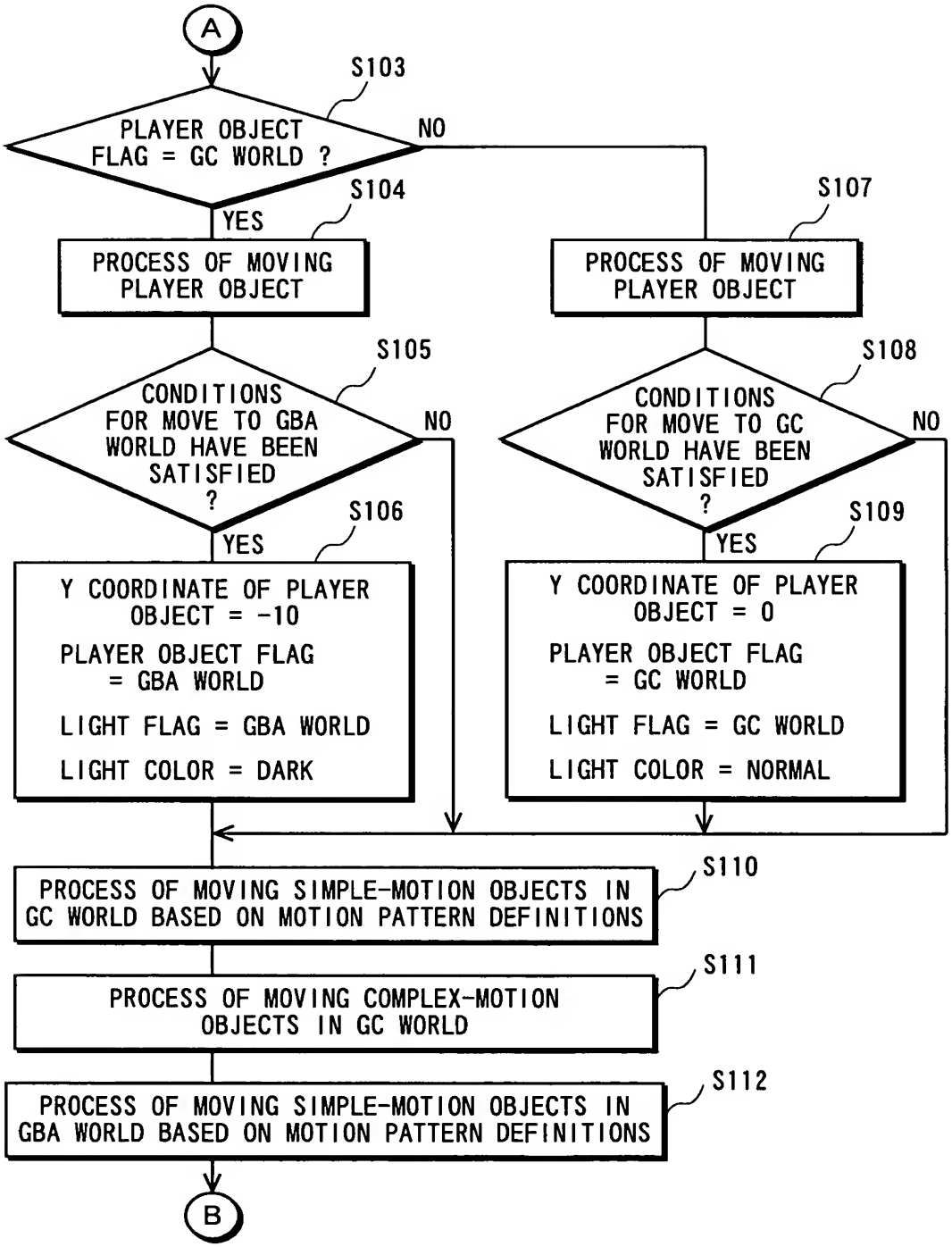

A
S103
PLAYER OBJECT FLAG = GC WORLD ?
NO
YES
S104
PROCESS OF MOVING PLAYER OBJECT
S105
CONDITIONS FOR MOVE TO GBA WORLD HAVE BEEN SATISFIED ?
NO
YES
S106
Y COORDINATE OF PLAYER OBJECT = -10
PLAYER OBJECT FLAG = GBA WORLD
LIGHT FLAG = GBA WORLD
LIGHT COLOR = DARK
S107
PROCESS OF MOVING PLAYER OBJECT
S108
CONDITIONS FOR MOVE TO GC WORLD HAVE BEEN SATISFIED ?
NO
YES
S109
Y COORDINATE OF PLAYER OBJECT = 0
PLAYER OBJECT FLAG = GC WORLD
LIGHT FLAG = GC WORLD
LIGHT COLOR = NORMAL
S110
PROCESS OF MOVING SIMPLE-MOTION OBJECTS IN GC WORLD BASED ON MOTION PATTERN DEFINITIONS
S111
PROCESS OF MOVING COMPLEX-MOTION OBJECTS IN GC WORLD
S112
PROCESS OF MOVING SIMPLE-MOTION OBJECTS IN GBA WORLD BASED ON MOTION PATTERN DEFINITIONS
B

FIG. 23

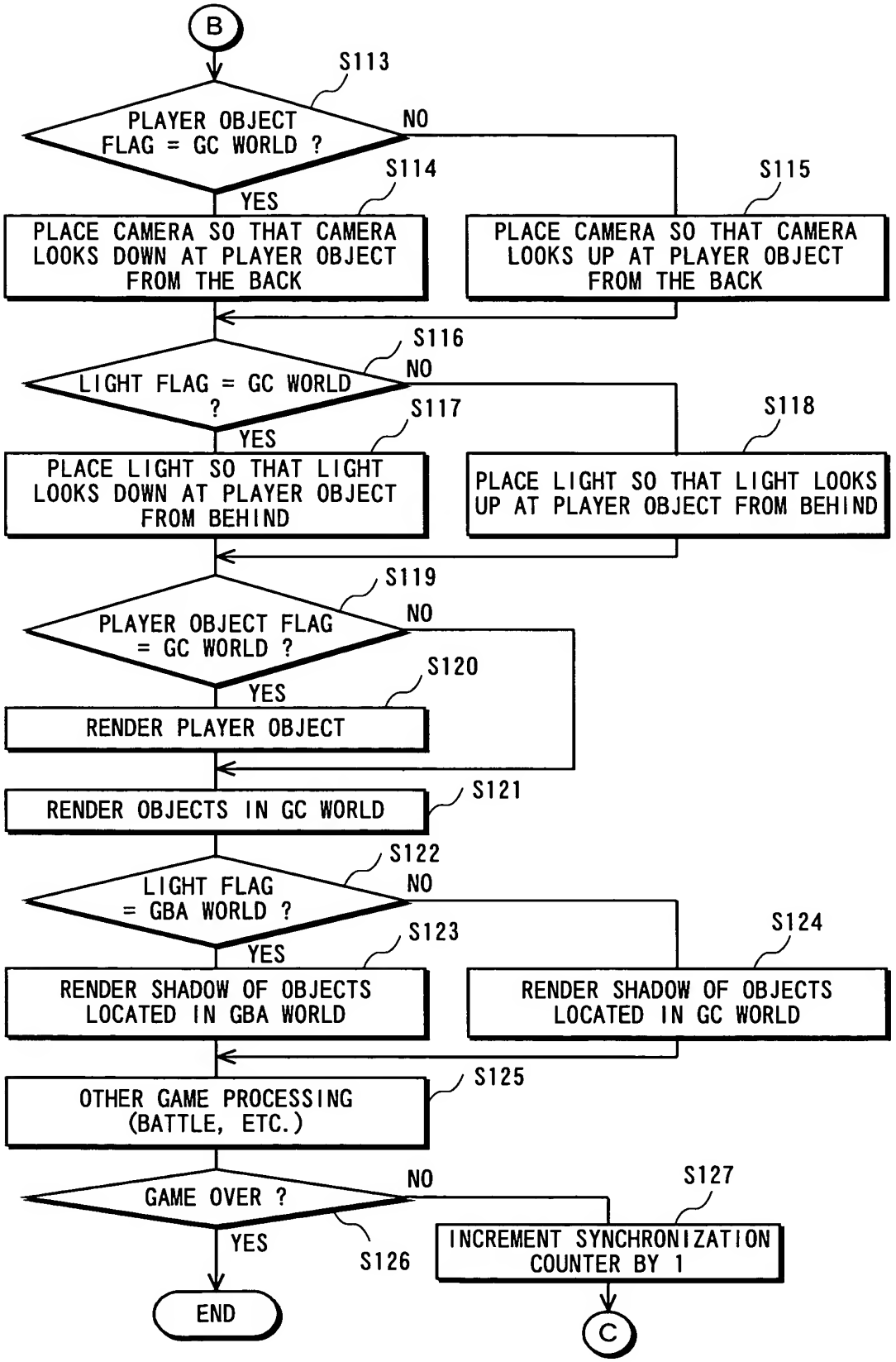

B
S113
PLAYER OBJECT FLAG = GC WORLD ?
NO
YES
S114
PLACE CAMERA SO THAT CAMERA LOOKS DOWN AT PLAYER OBJECT FROM THE BACK
S115
PLACE CAMERA SO THAT CAMERA LOOKS UP AT PLAYER OBJECT FROM THE BACK
S116
LIGHT FLAG = GC WORLD ?
NO
YES
S117
PLACE LIGHT SO THAT LIGHT LOOKS DOWN AT PLAYER OBJECT FROM BEHIND
S118
PLACE LIGHT SO THAT LIGHT LOOKS UP AT PLAYER OBJECT FROM BEHIND
S119
PLAYER OBJECT FLAG = GC WORLD ?
NO
YES
S120
RENDER PLAYER OBJECT
S121
RENDER OBJECTS IN GC WORLD
S122
LIGHT FLAG = GBA WORLD ?
NO
YES
S123
RENDER SHADOW OF OBJECTS LOCATED IN GBA WORLD
S124
RENDER SHADOW OF OBJECTS LOCATED IN GC WORLD
S125
OTHER GAME PROCESSING (BATTLE, ETC.)
GAME OVER ?
NO
YES
S126
S127
INCREMENT SYNCHRONIZATION COUNTER BY 1
END
C

FIG. 24

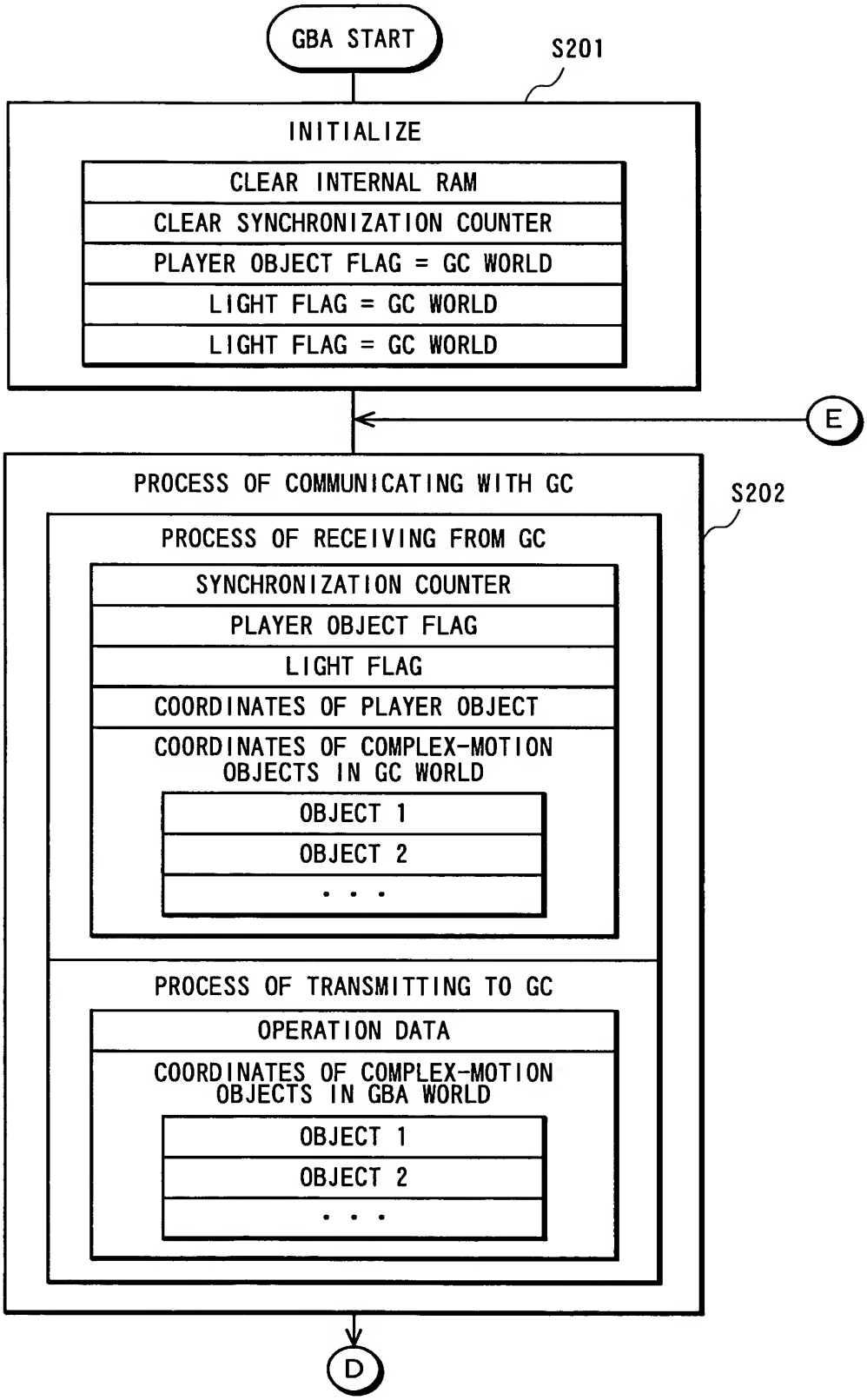
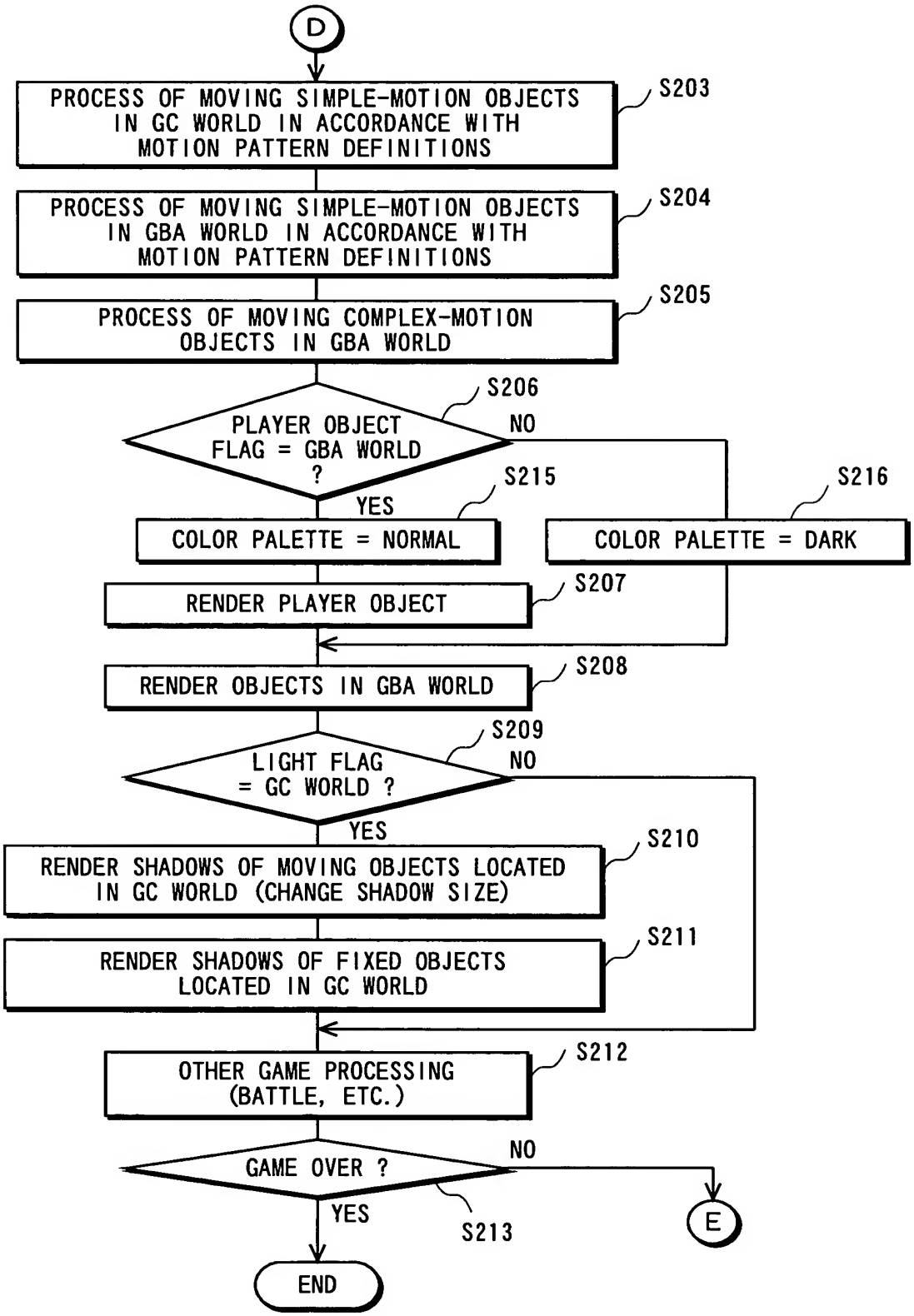

GBA START
S201
INITIALIZE
CLEAR INTERNAL RAM
CLEAR SYNCHRONIZATION COUNTER
PLAYER OBJECT FLAG = GC WORLD
LIGHT FLAG = GC WORLD
LIGHT FLAG = GC WORLD
E
PROCESS OF COMMUNICATING WITH GC
S202
PROCESS OF RECEIVING FROM GC
SYNCHRONIZATION COUNTER
PLAYER OBJECT FLAG
LIGHT FLAG
COORDINATES OF PLAYER OBJECT
COORDINATES OF COMPLEX-MOTION OBJECTS IN GC WORLD
OBJECT 1
OBJECT 2
. . .
PROCESS OF TRANSMITTING TO GC
OPERATION DATA
COORDINATES OF COMPLEX-MOTION OBJECTS IN GBA WORLD
OBJECT 1
OBJECT 2
. . .
D

FIG. 25


D
PROCESS OF MOVING SIMPLE-MOTION OBJECTS IN GC WORLD IN ACCORDANCE WITH MOTION PATTERN DEFINITIONS
S203
PROCESS OF MOVING SIMPLE-MOTION OBJECTS IN GBA WORLD IN ACCORDANCE WITH MOTION PATTERN DEFINITIONS
S204
PROCESS OF MOVING COMPLEX-MOTION OBJECTS IN GBA WORLD
S205
S206
PLAYER OBJECT FLAG = GBA WORLD ?
NO
YES
S215
COLOR PALETTE = NORMAL
S216
COLOR PALETTE = DARK
RENDER PLAYER OBJECT
S207
RENDER OBJECTS IN GBA WORLD
S208
S209
LIGHT FLAG = GC WORLD ?
NO
YES
RENDER SHADOWS OF MOVING OBJECTS LOCATED IN GC WORLD (CHANGE SHADOW SIZE)
S210
RENDER SHADOWS OF FIXED OBJECTS LOCATED IN GC WORLD
S211
OTHER GAME PROCESSING (BATTLE, ETC.)
S212
GAME OVER ?
NO
YES
S213
E
END